



Economies of Scale in Biogas Production

Skovsgaard, Lise ; Klinge Jacobsen, Henrik

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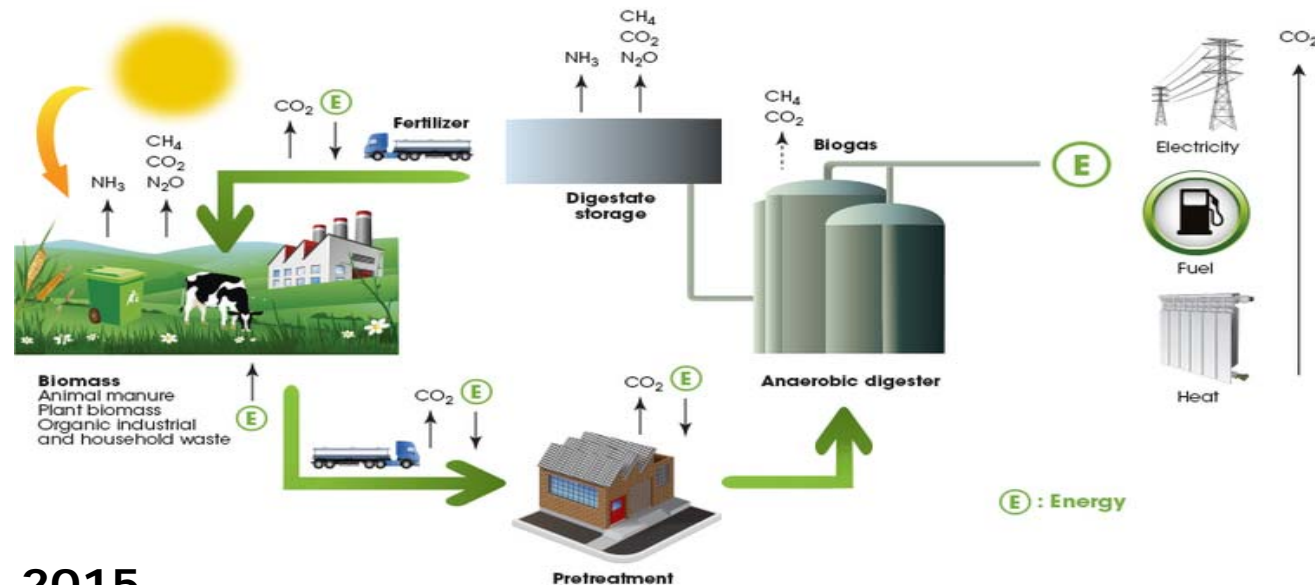
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Economies of Scale in Biogas Production and How to Organize Regulation



May 26, 2015

IAEE International Conference 2015 Antalya, Turkey

Session 25: Prospects of Biofuels

Lise Skovsgaard and Henrik Klinge Jacobsen

DTU Management Engineering

Department of Management Engineering

Economies of Scale in Biogas Production and How to Organize Regulation

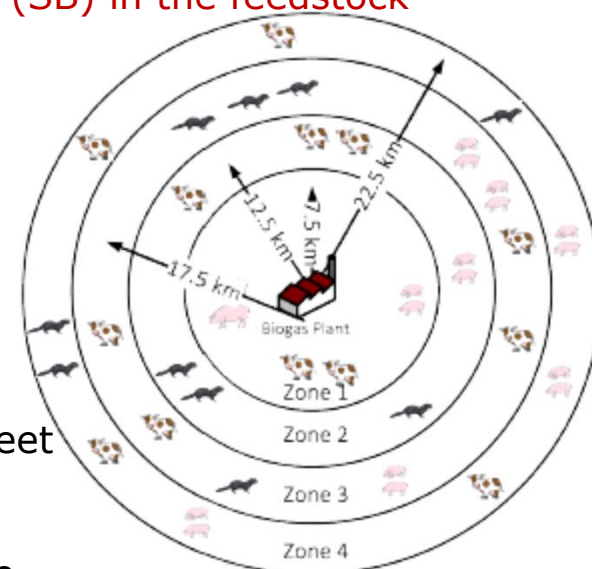
Agenda

1. The model
2. Focus on using only pig slurry, PSSB-0
 - Economy of scale
 - Sensitivity on net-income
 - Findings before sugar beet is added
3. When Sugar beet is added, PSSB-12.5 and PSSB-25
 - Economy of scale?
 - Cost factors
 - Findings on costs
4. Sensitivity on PSSB-12.5
5. Concluding remarks
6. Regulative implications

Economies of Scale in Biogas Production

The model: Feedstock, Scale and transport

- Three different plant sizes:
 - Small(110): 110.000 Mg of biomass p.a.
 - Medium(320): 320.000 Mg of biomass p.a.
 - Large(500) : 500.000 Mg of biomass p.a.
- Three mass-based ratios of Pig sludge (PS) and Sugar Beet (SB) in the feedstock are analysed:
 - PSSB-0: 100% PS, 0% SB
 - PSSB-12.5: 87.5% PS, 12.5% SB
 - PSSB-25: 75% PS, 25% SB
- Transport: Collection costs and density of resources
 - A specific location used, with actual distances
 - $\Delta d_j(M_j) = \frac{m_{1j}}{M_j} r_1 + \sum_{i=2}^{o(M_j)-1} \frac{m_{ij}-m_{i-1,j}}{M_j} r_i + \frac{M_j-m_{nj}}{M_j} r_n$
 - Trade off between short distance to manure or sugar beet
- Biogas sales – decision between upgrade or CHP
 - Small scale (biogas yield < 3.5 mill m3) => no upgrade
 - Large scale (biogas yield > 3.5 mill m3) => upgrade

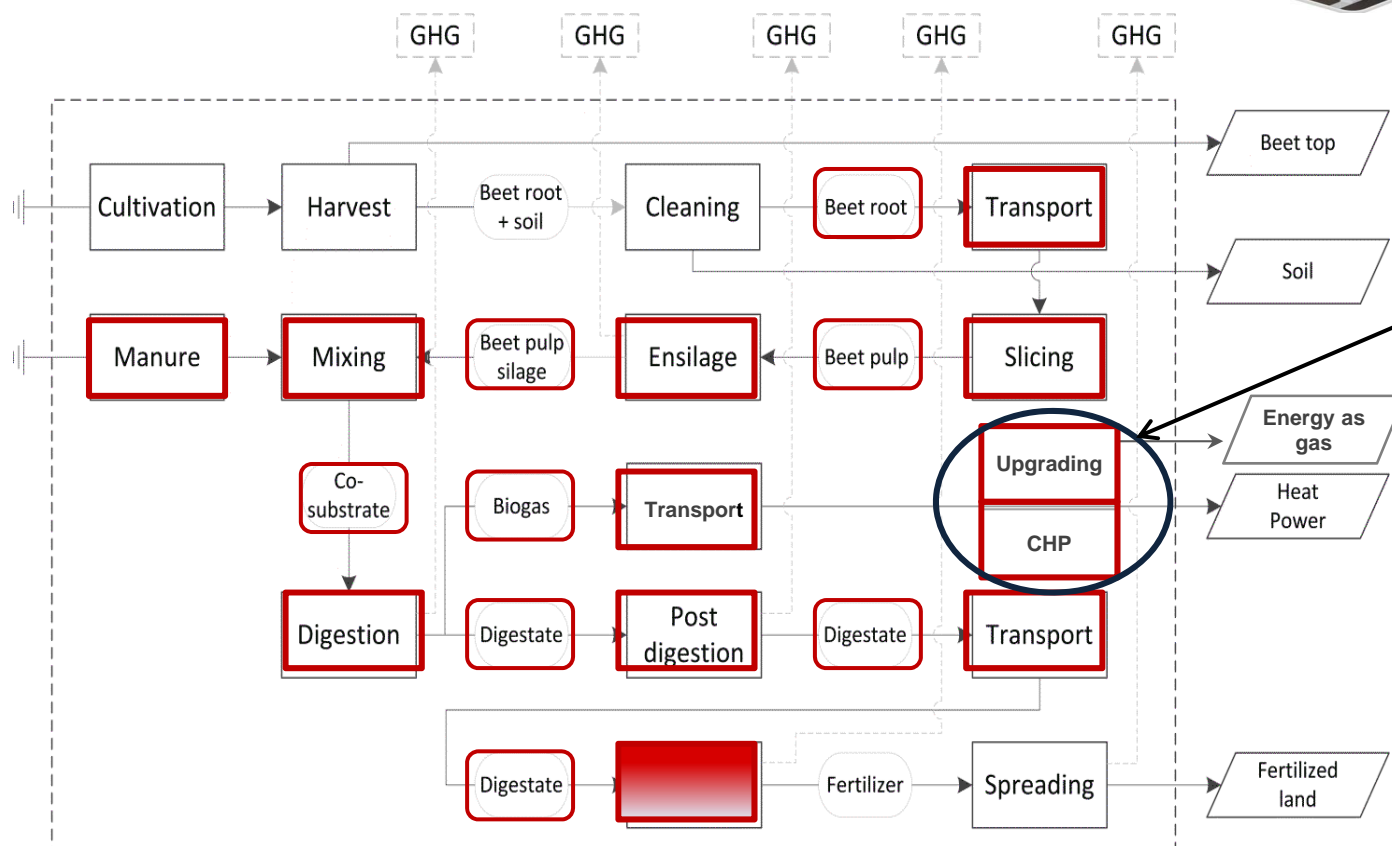
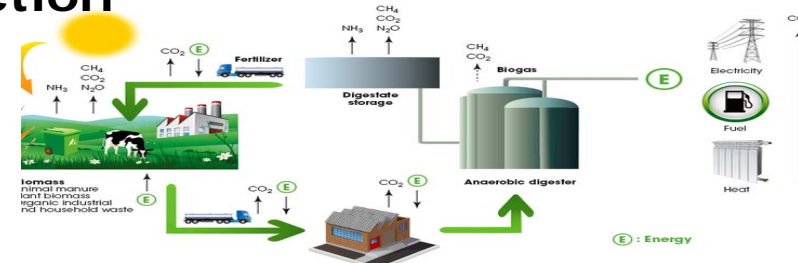


Economies of Scale in Biogas Production

The model

- The entire biochain

=> The economic model – the plant view

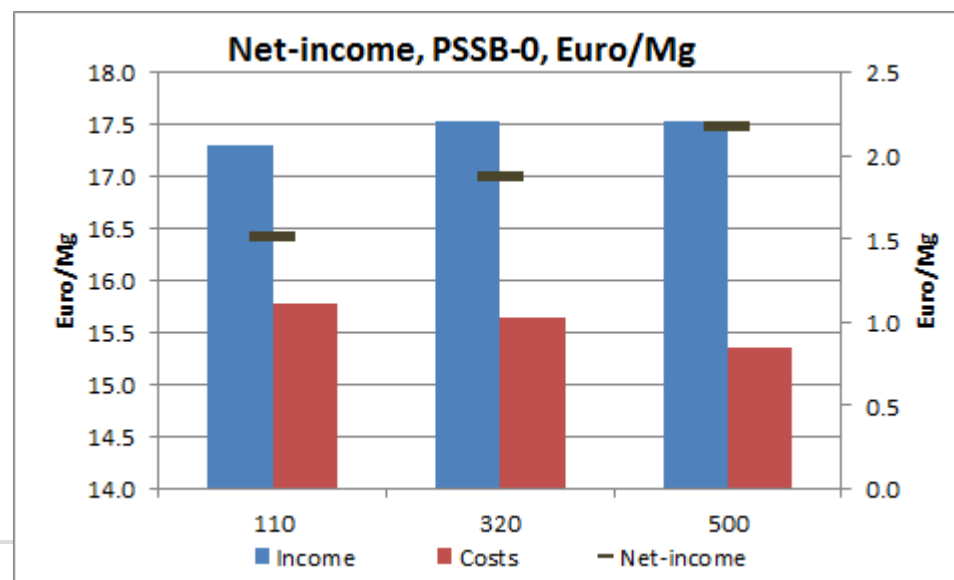


Upgrade when biogas yield > 3.5 mill m3,
 CHP when yield < 3.5 mill m3

Scale effects – economies of scale?

Expectations and overall results – PSSB-0

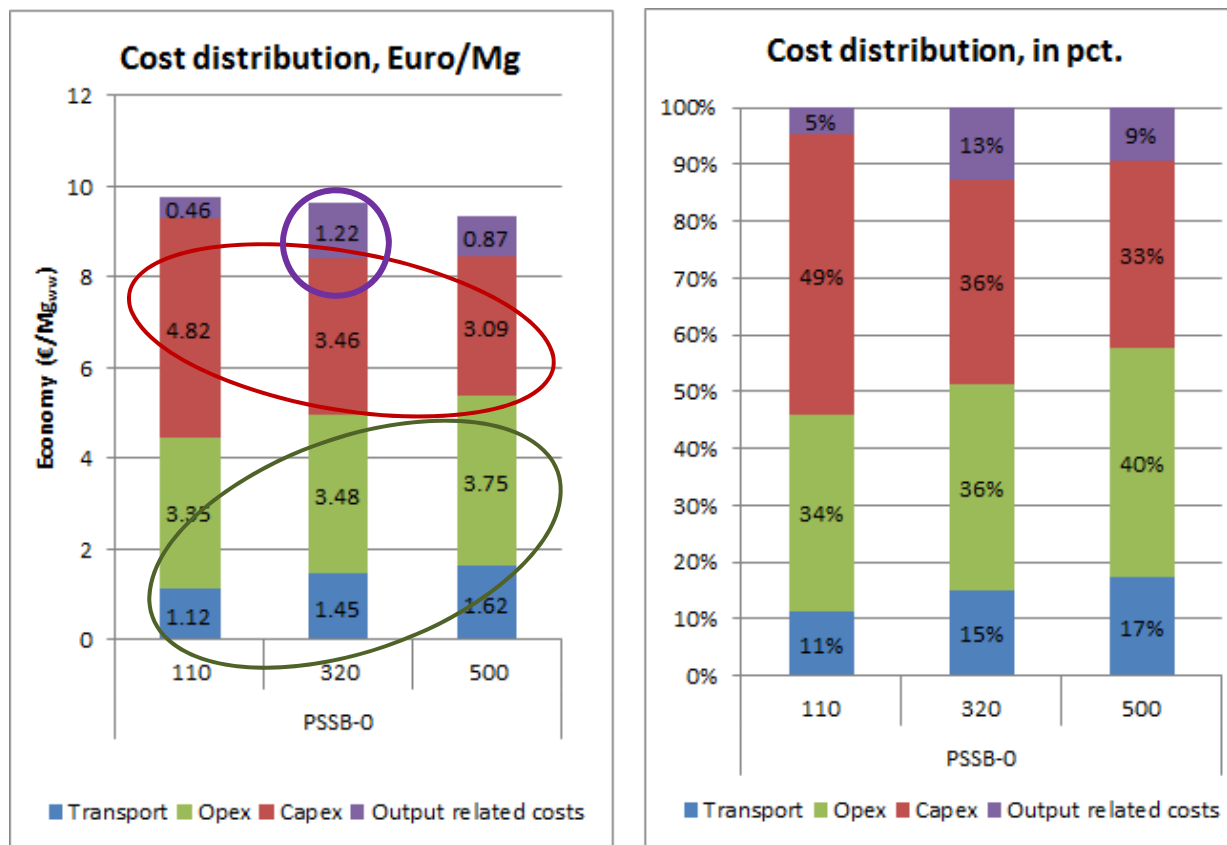
- Clear signs of economy of scale within PSSB-0 case
- Expectations
 - positive effect from capex
 - negative effect from transport



Net-income PSSB-0,Euro/Mg			
Ratio\Scale	110	320	500
Income	17.30	17.30	17.53
Costs	15.78	15.65	15.35
Net-income	1.52	1.65	2.18

Economy of scale – PSSB-0

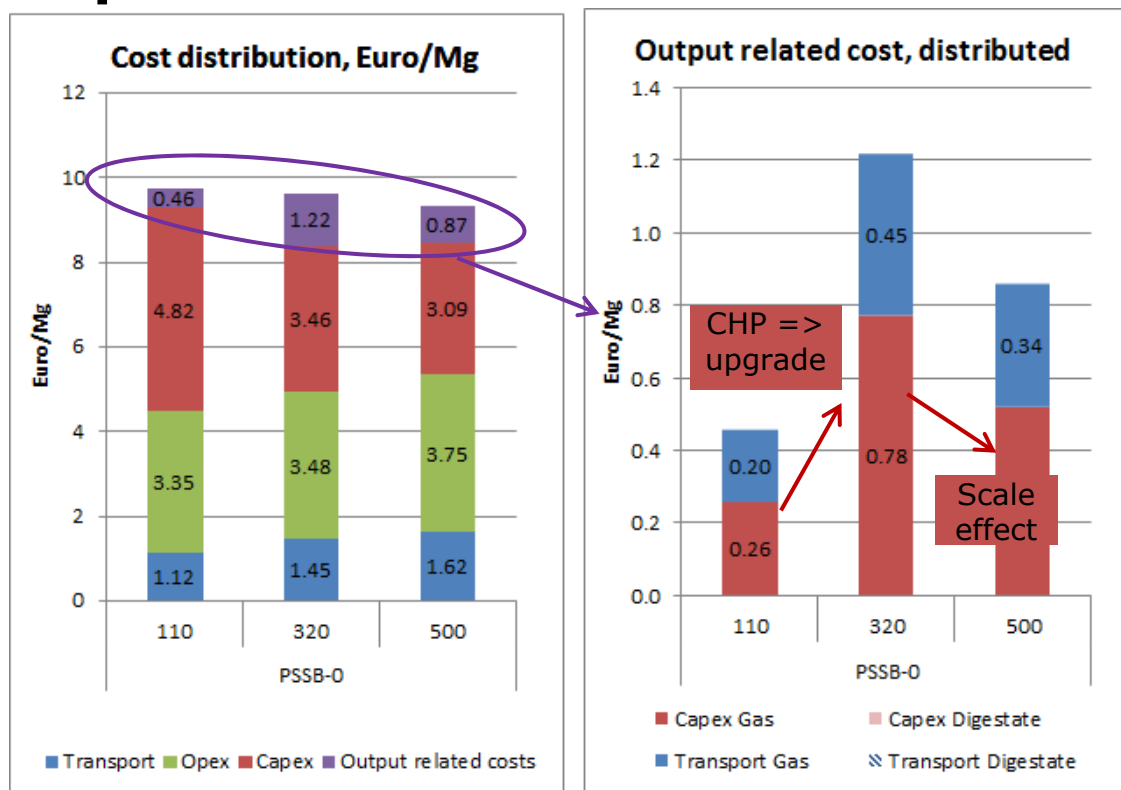
Cost distribution



- Clear sign of economy of scale
 - Trade off between capex and rising opex + transport costs –
 - Output related costs....?

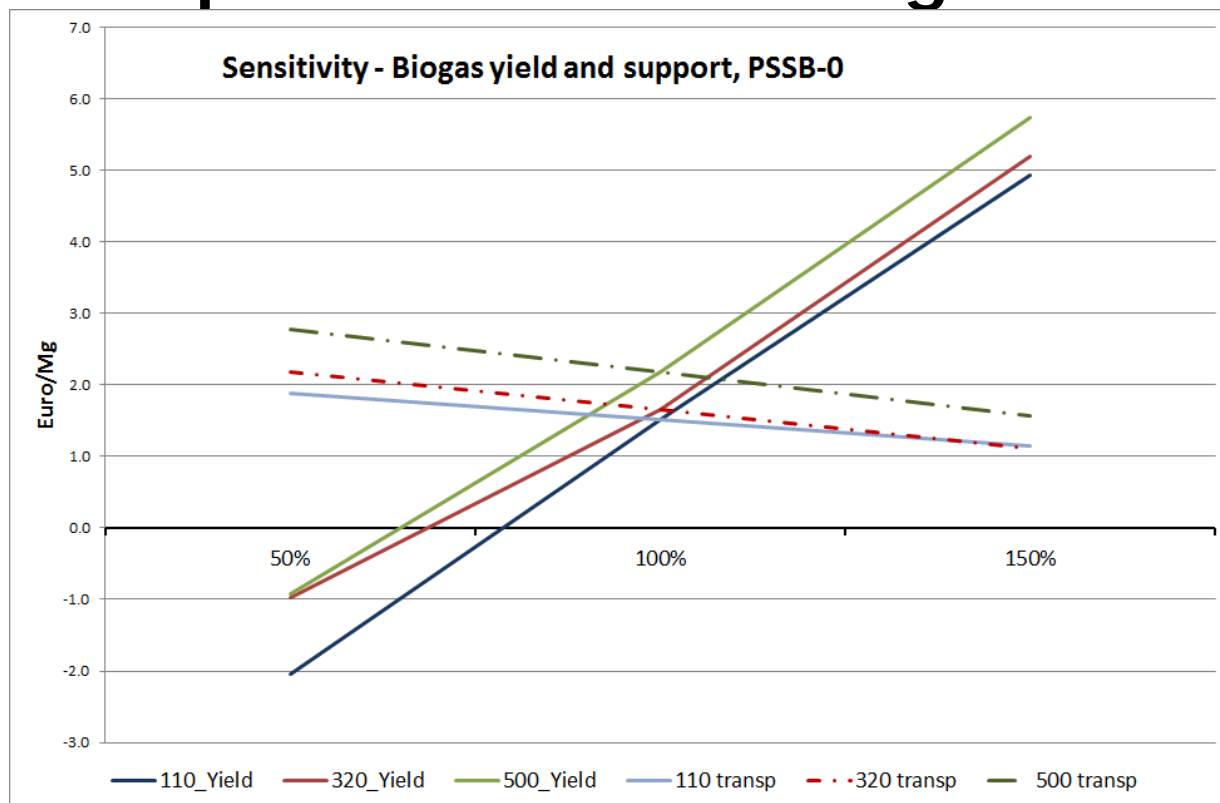
Economy of scale – PSSB-0

Output related costs



- Cost rise in capex and gas transport from small to medium size => change from CHP to Upgrade
- Economy of scale in Upgrade with cost reduction – from medium to large scale

Sensitivity on net income – PSSB-0 Effect on net income, with changes in Transport distance or Biogas Yield



- Net income robust compared to transport in the PSSB-0 case
- Regulative implications:
 - Biogas yield is important

Findings

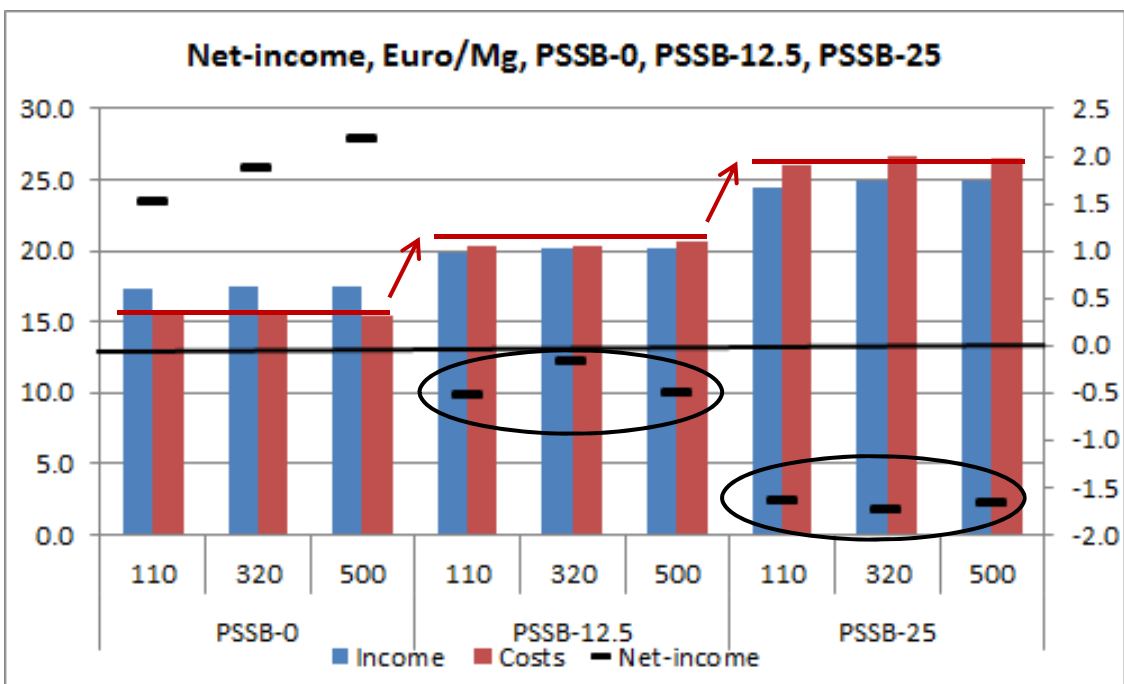
– before sugar beet is added

We find:

- Economy of scale when sugar beet is not added (case PSSB-0)
- Positive Net-income
 - Transport are costs not significant
 - Biogas yield important for results

=>=> Let's add a co-substrate e.g. Sugar beet

Adding sugar beet (SB) as input Results PSSB-0 vs. PSSB-12.5 and PSSB-25

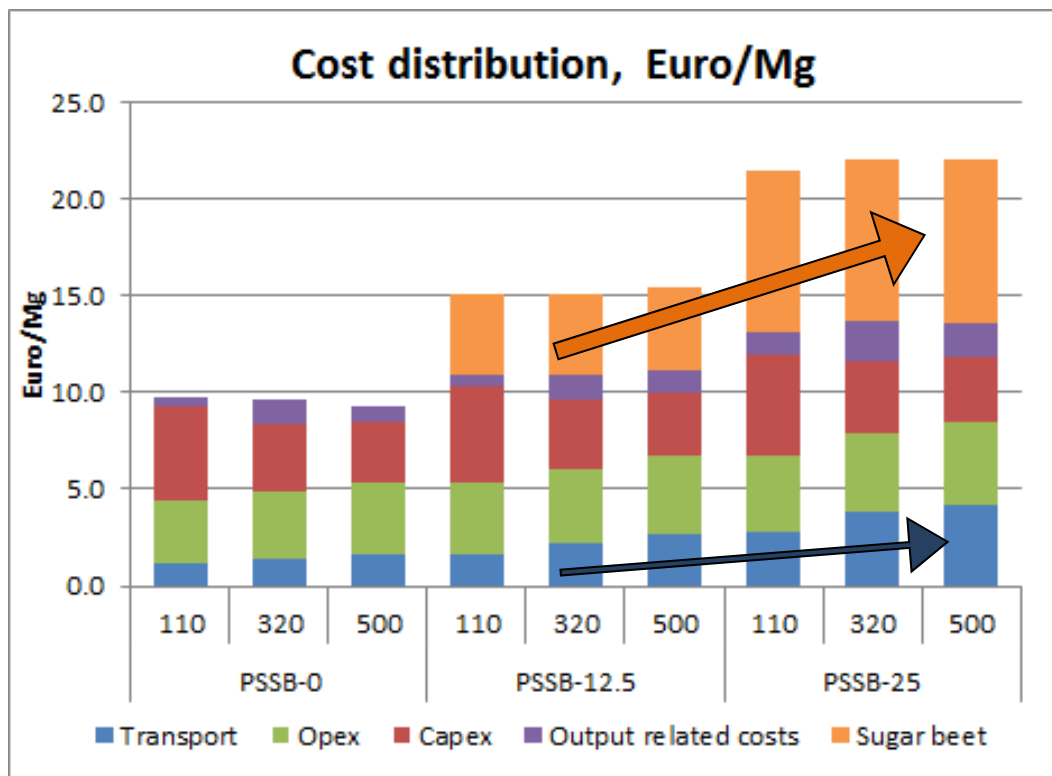


Increasing the share of beet

– initial observations

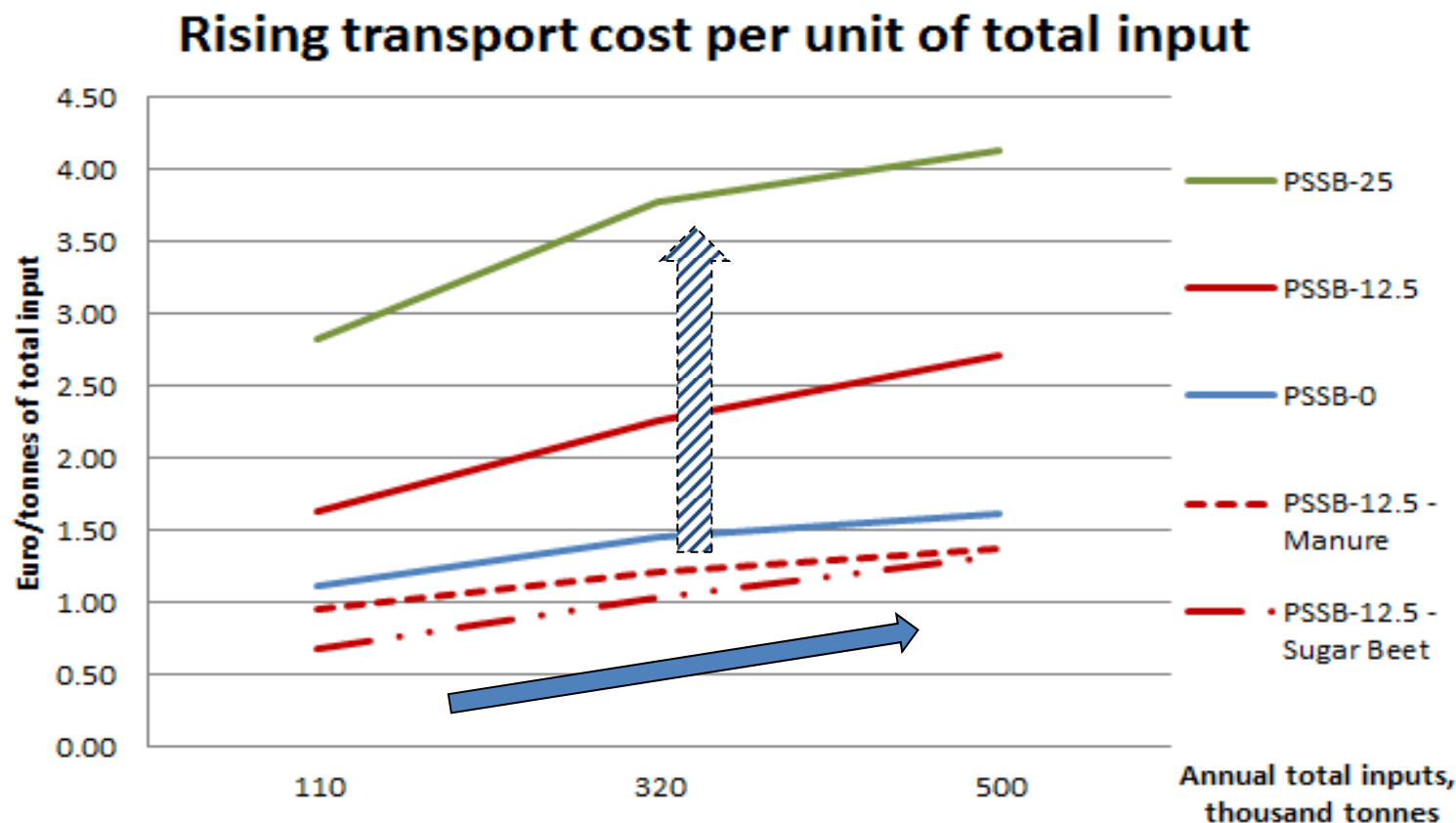
- Negative net-income in PSSB-12.5 and PSSB-25
- Unit Cost increase > Income increase
- Level of unit costs increases along with added sugar beet (SB)

Adding sugar beet (SB) as input Results PSSB-0 vs. PSSB-12.5 and PSSB-25



1. Sugar beet price >> manure price
2. Increased transport cost
 1. longer distance
 2. one-way transport
3. Output related costs

Adding sugar beet (SB) as input Effect on transport costs



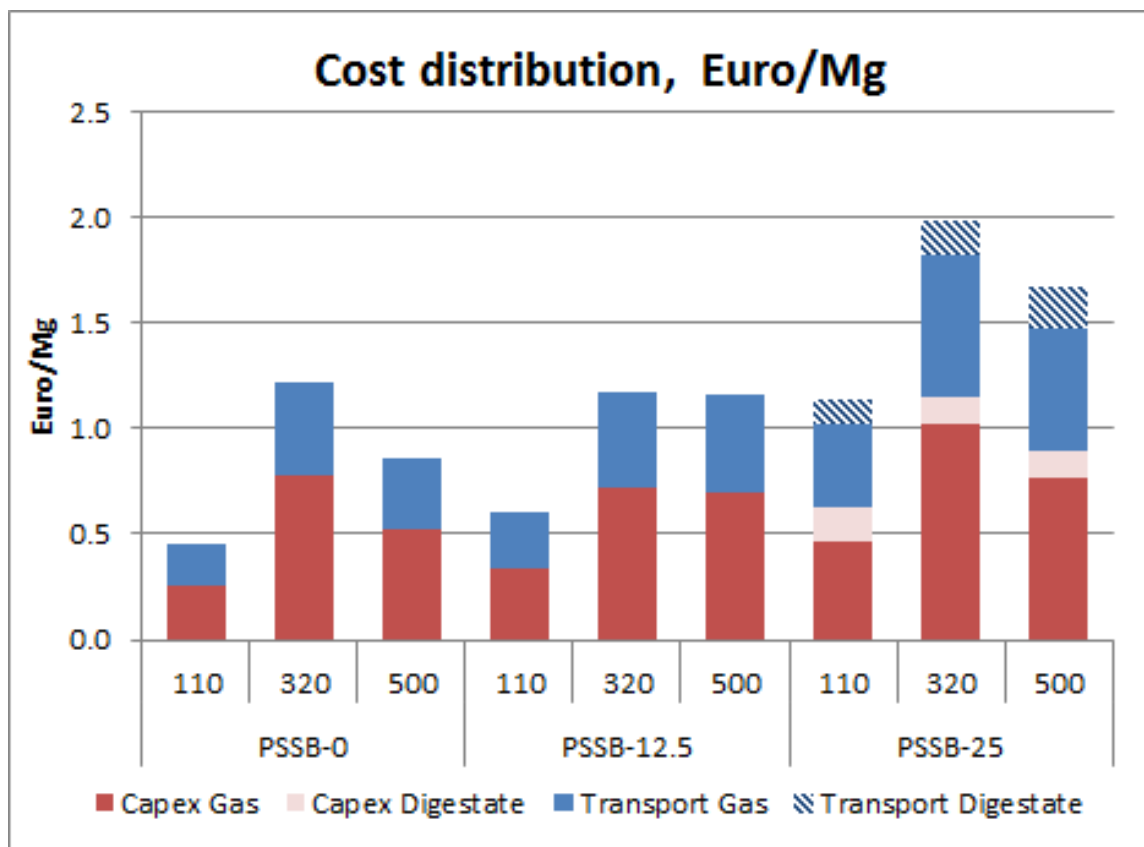
Increase in transport cost due to:

- higher beet share
- size of plant

Adding sugar beet (SB) as input

Output related costs

- Scale effects on output costs
 - CHP=> upgrade
 - Upgrade technology
- In PSSB-25 case additional costs with digestate
 - Storage and
 - Transport



Findings on costs

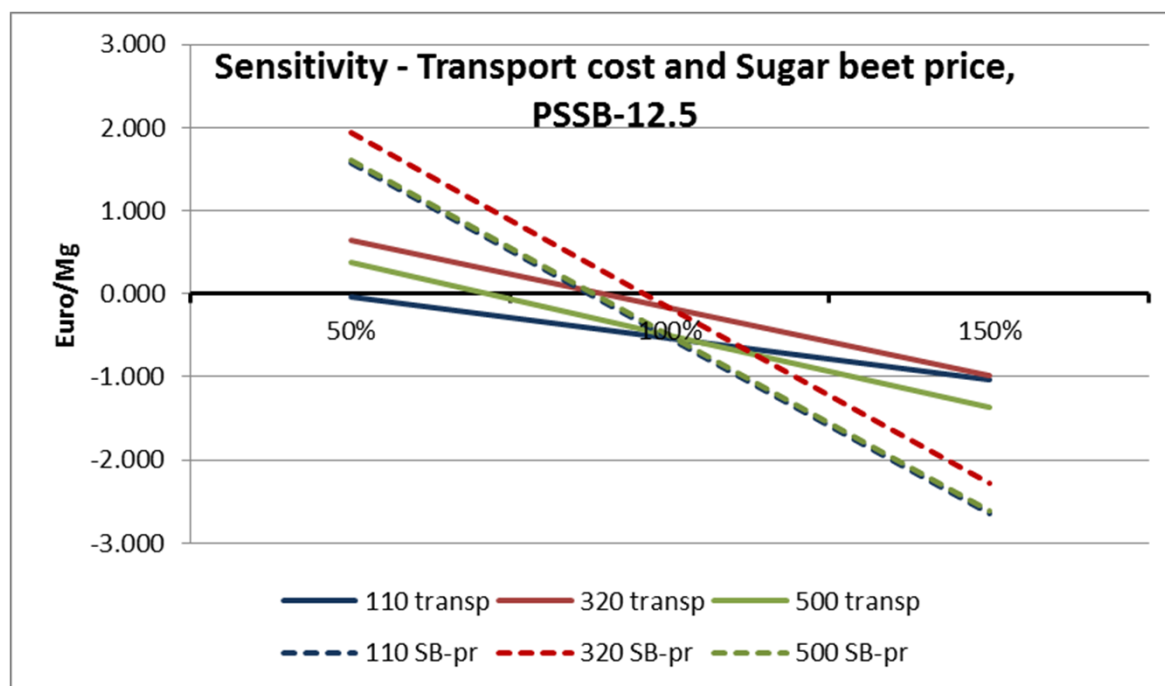
– When sugar beet is added

We find:

- Tendency to Economy of scale in:
 - Capex: all cases (case PSSB-0, PSSB-12.5 and PSSB-25)
- Overall the positive scale effect in Capex is outweighed by transport, Opex and in output related costs
- General costs remarks, when sugar beet is added
 - Generally higher costs allround – particularly in
 - Sugar beet costs
 - Transport costs
 - Opex

Sensitivity on Net income – adding sugar beet as input PSSB-12.5

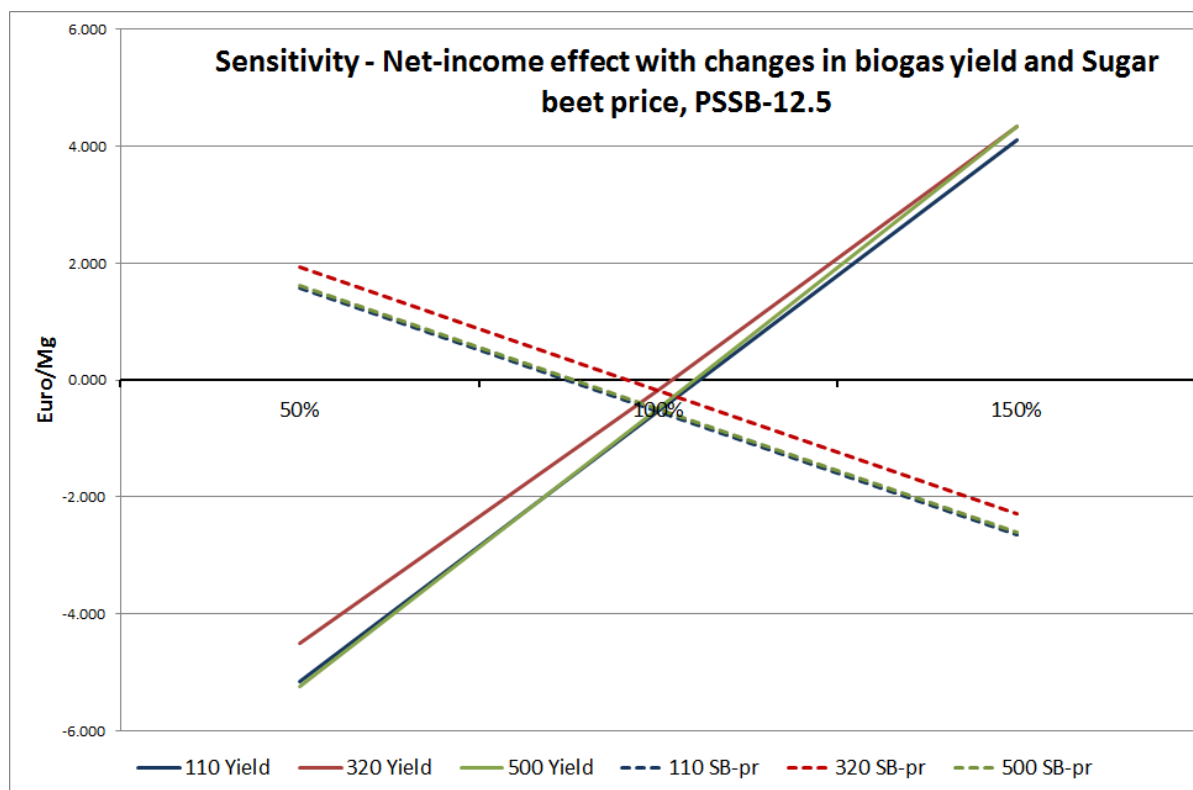
Effect on net-income, when **sugar beet** or **transport costs** are changed



- A reduction in transport costs can hardly turn the negative net-income, while a significant reduction in sugar beet price can

Sensitivity on Net income – adding sugar beet as input - PSSB-12.5

Effect on net-income, when **Biogas yield** or **sugar beet costs** are changed



- Yield still seems to have the higher influence on net-income

Overall concluding remarks

Economy of scale

- Economy of scale in capex ↑
 - Potential in large scale production and upgrading
- Transport costs ↓
 - Transport plays a significant role, particularly when sugar beet is added =>
 - Try to "buy local" (feed-stock and manure) =>

Net-income effects – critical parameters

- Input price
 - Sugar beet price is high and dominates costs in PSSB-12.5 and PSSB-25 => relevant with flexible input demand
- Yield
 - Yield seems to be the highest factor on net income results => focus on yield

Overall concluding remarks

- regulative implications

Concluding remarks

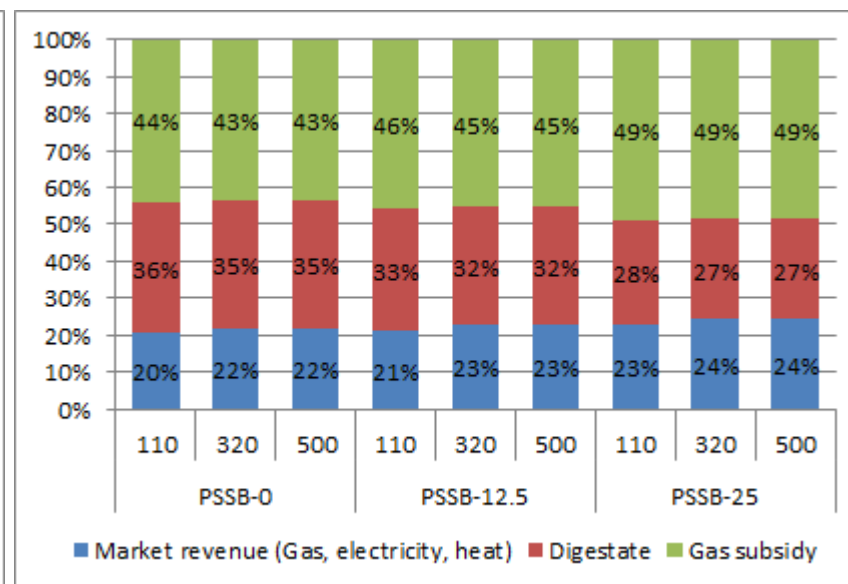
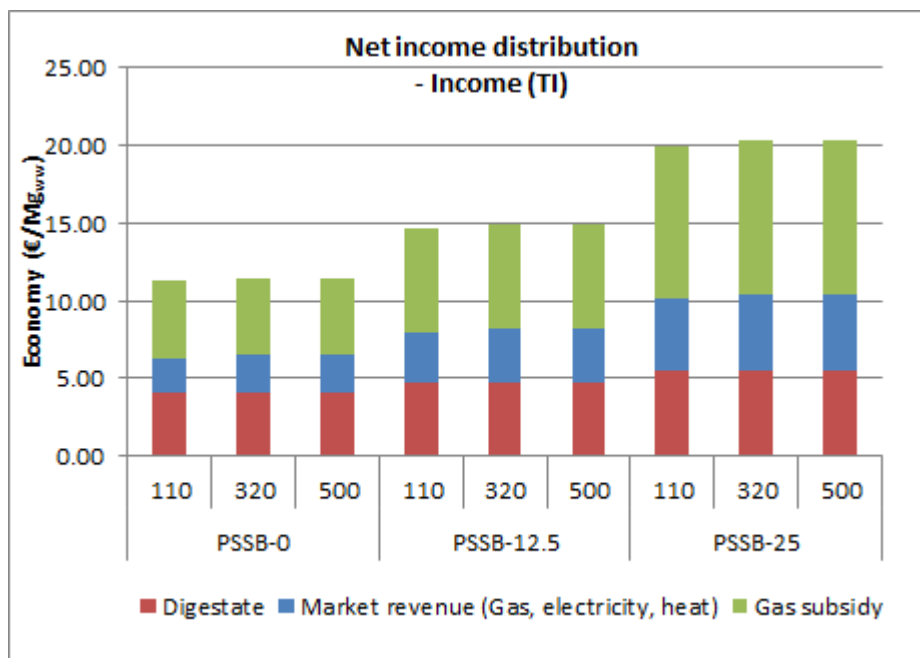
- Economy of scale
- Transport costs important
- Input price important
- Yield important

Regulative implications

- Economy of scale
 - Support/allow large scale facilities and upgrading
- Transport costs
 - Facilitate (do not hinder) use of local feedstock =>
- Input price
 - Facilitate flexible input =>
- Yield
 - Facilitate high yield =>

=> Reconsider restrictions on potential input
=> the effects on biogas income,
compared to other considerations

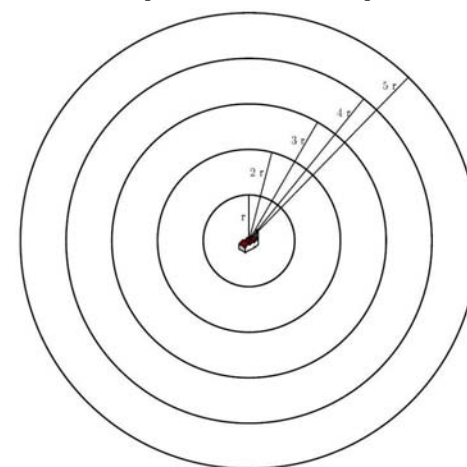
Additional – Income distribution



Additional – Transport formula_1

- The available pig slurry and sugar beet are divided into the amount available within the different radii and, by doing this, the average transportation distance (Δd) can be calculated as follows:
- $$\Delta d_j(M_j) = \frac{m_{1j}}{M_j} r_1 + \sum_{i=2}^{o(M_j)-1} \frac{m_{ij}-m_{i-1,j}}{M_j} r_i + \frac{M_j-m_{nj}}{M_j} r_n$$
- where m_{ij} is the mass of biomass j available in circle i ; M_j is the total mass of biomass j needed for the specific setting of plant size and ratio; r_j is the radius of circle i ; and $o(M_j)$ is the last circle needed for satisfying the requested demand. The average transportation distance (Δd , in km) for the different input mix is estimated in the table

Input	Unit	Input	Plant capacity (1'000 Mg)		
			110	320	500
PSSB-0	km	Sugar beet	0	0	0
	km	Pig slurry	6.1	8.9	10.3
PSSB-12.5	km	Sugar beet	23.2	44.0	60.9
	km	Pig slurry	5.9	8.4	9.9
PSSB-25	km	Sugar beet	42.9	65.1	70.4
	km	Pig slurry	5.5	7.6	9.5

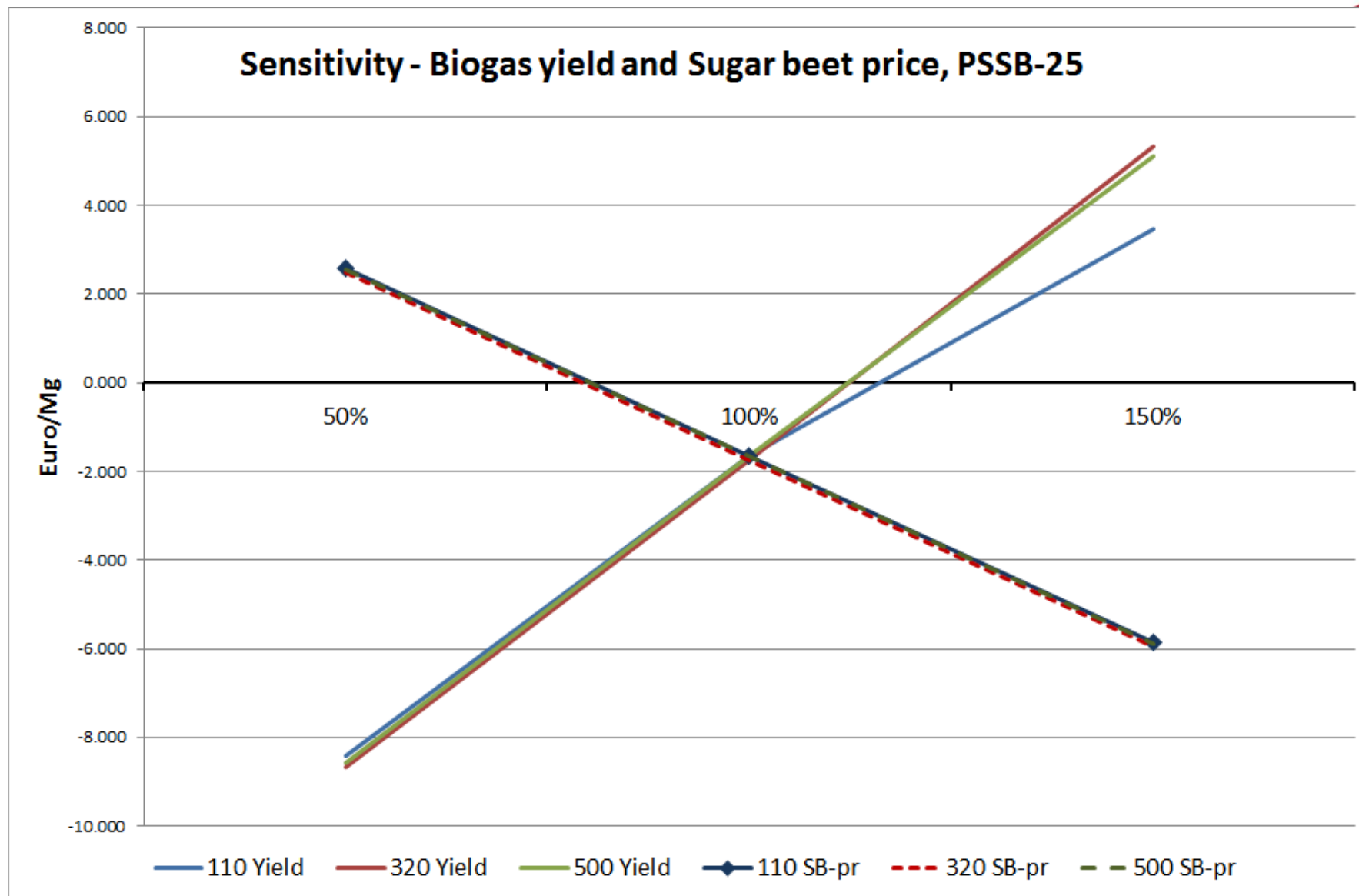


Additional – Transport formula_2

- After applying the formula for all plant sizes and ratios, the cost of collecting the pig slurry and sugar beet ($C_{trans,in}$) can be calculated as follows:

$$C_{trans,in}(M_j) = \sum_{j \in J} \left(2 \cdot \frac{M_j \cdot \Delta d_j(M_j) \cdot p_j^{trans}}{cap_j \cdot \rho_j \cdot v_j} + \frac{M_j \cdot (t_j^{load} \cdot p_j^{load} + t_j^{unload} \cdot p_j^{unload})}{cap_j \cdot \rho_j} \right)$$

- The first fraction represents the cost of transporting the biomass, and the parameters represent: p_j^{trans} , the price for transporting biomass type j ; v_j is the speed of the truck used for transporting the biomass j (i.e. 50 km/hour); cap_j is the capacity of the truck used for biomass type j (i.e. 31.2 and 35 Mg/load for sugar beet and pig slurry respectively); and ρ_j is the density of biomass type j (i.e. 1 and 0.65 Mg/m³ for sugar beet and pig slurry respectively). The fraction is multiplied by 2, as the truck has to return to the plant after delivering the biomass. In case the trip is about pig slurry transport, the trip out to the farmer will include the delivery of digestate. An estimation of the transportation costs (€) on an annual basis is provided in Table S14. The second fraction represents the costs of loading and unloading the truck, and the parameters represent: t_j^{load}/t_j^{unload} is the time for loading/unloading biomass type j ; p_j^{load}/p_j^{unload} is the hourly price of loading/unloading (i.e. 87 and 104 €/hour for sugar beet and pig slurry respectively)





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Conference Program

Quick Links: [Sunday, 24 May](#) | [Monday, 25 May](#) | [Tuesday, 26 May](#) | [Wednesday, 27 May](#)

SUNDAY, 24 MAY 2015

IAEE COUNCIL MEETING (BY INVITATION)

9:00am - 5:00pm • Gloria Serenity Faces 3

IAEE COUNCIL LUNCH (BY INVITATION)

12:30pm - 1:30pm • Gloria Serenity Main Restaurant

WORKSHOP: "OPTIMIZING YOUR PRESENTATION SKILLS"

10:00am - 12:30pm • Gloria Serenity Faces 1

[Click for more information](#)

WORKSHOP: "SHALE GAS IN NORTH AMERICA"

2:00pm - 5:00pm • Gloria Serenity Faces 1

[Click for more information](#)

PHD DAY SESSION

1:15pm - 6:00pm • Gloria Serenity Faces 2

STUDENT HAPPY HOUR

6:00pm - 7:00pm • Gloria Serenity Lobby Bar Terrace

REGISTRATION

12:00n - 6:30pm • Gloria Golf Convention Center

OPENING RECEPTION

7:00pm - 8:30pm • Acisu Green Area

MONDAY, 25 MAY 2015

REGISTRATION

7:00am - 7:00pm • Saka

STUDENT BREAKFAST MEETING

8:30am - 9:30am • Manyas 3

TUESDAY, 26 MAY 2015

REGISTRATION

7:00am - 6:30pm • Saka

EUROPEAN AFFILIATE LEADERSHIP MEETING

7:30am - 8:30am • Turna 2-3

WEDNESDAY, 27 MAY 2015

REGISTRATION

7:00am - 6:00pm • Saka

2016 IAEE INTERNATIONAL CONFERENCE PLANNING MEETING

7:30am - 8:30am • Anka 1-2

IAEE AFFILIATE LEADERS MEETING

8:30am - 9:30am • Turna 2-3

WELCOME, PRESIDENTIAL ADDRESS & KEYNOTE SESSION: CLIMATE CHANGE

10:00am - 12:00n • Entertainment Center

Prof. Gürkan Kumbaroğlu (Presiding)
President Elect, IAEE; Boğaziçi University, Turkey

Mr. Masakazu Toyoda
Chairman and CEO, The Institute of Energy Economics, Japan

Dr. Jim Plummer
President, Climate Economics Foundation, USA

Dr. Michael Canes
Distinguished Fellow, Logistics Management Institute, USA

Prof. Richard Tol
University of Sussex, UK

PHOTOGRAPHY EXHIBITION OPENING

12:15 • Gloria Convention Center

LUNCH

12:20pm - 1:30pm • Anatolia Restaurant, Gloria Golf Resort

DUAL PLENARY SESSION: GEOPOLITICS OF GAS[\(Click for session description\)](#)

1:30pm - 3:00pm • Manyas 1

Dr. Tatiana Mitrova (Presiding)
Head of Oil and Gas Department, Energy Research Institute of the Russian Academy of Sciences (ERIRAS), Russia

Mr. Leonid Grigoryev
Chief Adviser to the Head of Analytical Center of the Government of the Russian Federation, Russia

Prof. Peter Hartley
President, IAEE; University of Western Australia, Australia

Dr. Xunpeng Shi
Senior Fellow, Energy Studies Institute, National University of Singapore, Singapore

DUAL PLENARY SESSION: ELECTRICITY FINANCE AND ELECTRICITY MARKET DESIGN[\(Click for session description\)](#)

1:30pm - 3:00pm • Manyas 2

Prof. Georg Erdmann (Presiding)
Berlin University of Technology, Germany

Prof. Lars Bergman
Stockholm School of Economics, Sweden

Mr. Christophe Bonnery
Director, Economics and Prospective, ERDF, France

EJ BOARD OF EDITORS MEETING

7:30am - 8:30am • Kumru

EEEP BOARD OF EDITORS MEETING

7:30am - 8:30am • Anka 1-2

DUAL PLENARY SESSION: OIL AND GAS TRANSPORT ISSUES

8:30am - 10:00am • Manyas 1

Prof. Ilhan Or (Presiding)
Graduate Institute Director, Bogazici University, Turkey

Prof. Ivan Gudkov
Moscow State University of International Affairs, Russia

Mr. Nedim Özyol
Deputy General Manager, Botaş, Turkey

Dr. S. M. Hossein Adeli
Sec. General, Gas Exporting Countries Forum, GECF, Qatar

Dr. Jennifer Coolidge
Executive Director, CMX Caspian and Gulf Consultants, Iraq

DUAL PLENARY SESSION: LONG TERM LOW CARBON DEVELOPMENT PATHWAYS[\(Click for session description\)](#)

8:30am - 10:00am • Manyas 2

Prof. Ying Fan (Presiding)
Member, Academy of Science, China

Prof. Wenying Chen
Institute of Energy, Tsinghua University, China

Prof. Andreas Löschel
Center for Applied Econ. Research, University of Münster, Germany

Dr. Olav Peter Hypher
Country Manager, Statkraft, Turkey

COFFEE BREAK

10:00am - 10:30am • Foyer area

CONCURRENT SESSIONS10:30am - 12:00n • [Click here for details](#)**LUNCH**

12:15pm - 1:30pm • Anatolia Restaurant, Gloria Golf Resort

DUAL PLENARY SESSION: GEOPOLITICS OF OIL WITH FOCUS ON MIDDLE EAST AND AFRICA

1:30pm - 3:00pm • Manyas 1

Dr. Carlo Andrea Bollino (Presiding)
President, AIEE, Italy

ASIAN AFFILIATE LEADERSHIP & PERTH 2016 CONFERENCE PLANNING MEETING

7:30am - 8:30am • Turna 2-3

DUAL PLENARY SESSION: NEW ENERGY TECHNOLOGIES AND THEIR STATUS

8:30am - 10:00am • Manyas 1

Prof. Reinhard Madlener (Presiding)
RWTH Aachen University, Germany

Dr. Akira Yoshino
General Manager, Yoshino Lab., Asahi Kasei Corp, Japan

Dr. Sean McCoy
CCS Unit, IEA, France

Dr. David Mooney
Director, Strat. Ener. Anal., National Renewable Energy Lab, USA

DUAL PLENARY SESSION: ENERGY ACCESS[\(Click for session description\)](#)

8:30am - 10:00am • Manyas 2

Prof. Wumi Iledare (Presiding)
Director, Emerald Energy Inst., University of Port Harcourt, Nigeria

Prof. Adeola Adenikinju
Director, Center for Energy Econ., University of Ibadan, Nigeria

Dr. Shonali Pachauri
Energy Prog.Intl. Inst. for Applied Syst. Anal. (IIASA), Austria

Dr. Ricardo Raineri
Former Energy Minister, Chile

COFFEE BREAK

10:00am - 10:30am • Foyer area

CONCURRENT SESSIONS10:30pm - 12:00n • [Click here for details](#)**LUNCH**

12:15pm - 1:50pm • Anatolia Restaurant, Gloria Golf Resort

CONCURRENT SESSIONS1:30pm - 3:00pm • [Click here for details](#)**COFFEE BREAK**

3:00pm - 3:30pm • Foyer area

DUAL CLOSING PLENARY SESSION: INTERNATIONAL IMPLICATIONS OF US ENERGY RENAISSANCE[\(Click for session description\)](#)

Ms. Silvia Kreibiehl
Head, UNEP Collaborating Center for Climate and Sustainable Energy, Frankfurt School of Finance, Germany

COFFEE BREAK & STUDENT POSTER SESSION

3:00pm - 3:30pm • Foyer Area
[Click for poster session details](#)

Sponsored By: Turcas

CONCURRENT SESSIONS

3:30pm - 5:00pm • [Click here for details](#)

CONCURRENT SESSIONS

5:15pm - 6:45pm • [Click here for details](#)

DINNER

7:00pm - 8:30pm • Anatolia Restaurant, Gloria Golf Resort

CONFERENCE NETWORKING RECEPTION

9:00pm - 11:00pm • Gloria Golf Course

Mr. Timothy Okon
Director, Nigerian National Petroleum Corporation, Nigeria

Dr. James Smith
Cary Maguire Chair in Oil and Gas Management, Southern Methodist Univ., USA

Mr. Sinan Ülgen
Chairman, Center for Econ. & Foreign Policy Studies, Turkey

DUAL PLENARY SESSION: ENERGY EFFICIENCY

[\(Click for session description\)](#)

1:30pm - 3:00pm • Manyas 2

Prof. Einar Hope (Presiding)
Norwegian School of Economics, Norway

Prof. James Sweeney
Director, Precourt Energy Eff. Center, Stanford University, USA

Mr. Samuel Thomas
Energy Efficiency Unit, IEA, France

Mr. Torkil Tyvold
Business Development, Norsk Hydro, Norway

COFFEE BREAK

3:00pm - 3:30pm • Foyer Area

CONCURRENT SESSIONS

3:30pm - 5:00pm • [Click here for details](#)

IAEE AWARDS CEREMONY

5:00pm - 6:30pm • Manyas 2

IAEE GENERAL MEMBERSHIP MEETING

6:30pm - 7:00pm • Turna 1

DINNER

7:00pm - 9:00pm • Anatolia Restaurant, Gloria Golf Resort

GLORIA WIDE ENTERTAINMENT

9:45pm - 10:30pm • Entertainment Center

GLORIA WIDE ISTANBUL PARTY

10:00pm - Midnight • []

3:30pm - 5:15pm • Manyas 2

Dr. Mine Yücel (Presiding)
Vice President, Federal Reserve Bank Dallas, USA

Prof. Hillard Huntington
Exec. Director, Energy Modeling Forum, Stanford Univ., USA

Dr. Zhen Wang
Dep. Dir. Gen., Policy Res., China Nat. Petroleum Corp., China

Mr. Laszlo Varro
Head, Gas, Coal & Electricity Markets, IEA, France

Prof. Scott Tinker
Director, BEG, University of Texas, Austin, USA

DUAL CLOSING PLENARY SESSION: AN INTEGRATED EURO-MEDITERRANEAN ENERGY MARKET

[\(Click for session description\)](#)

3:30pm - 5:15pm • Manyas 1

Ms. Silvia Pariente-David (Presiding)
Senior Energy Specialist

Mr. Abdelaziz Rassaa
Former Minister of Industry and Technology of Tunisia, Tunisia

Dr. Samuel Furfari
Advisor to Director General of Energy, European Commission

Mr. Hasan Hüseyin Erdogan
Deputy Head of Strategy Development, Ministry of Energy and Natural Resources, Turkey

Ms. Dayae Oudghiri
Member of the Board, MASEN, Morocco

CLOSING REMARKS

5:00pm - 5:15pm • Manyas 2

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Concurrent Sessions

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CONCURRENT SESSIONS 1-9 Monday, May 25, 3:30pm - 5:00pm
1. Geopolitics of Gas 1 (Manyas 2)
Michael E. Canes, Presiding Distinguished Fellow Logistics Management Institute
New Alignments and the Security of Supply in the EU Countries: Investigating the Role of Russia and Iran With a Game Theoretic Approach Hamed Sahebbonar Ferdowdi University View Extended Abstract View Paper
Future of Natural Gas in EU: Will Geopolitics Take over Economics? Yuri Yegorov Jalal Dehnavi Franz Wirl University of Vienna View Abstract View Paper
Changes in EU Future Natural Gas Supply and the Role of Turkish Hub Jalal Dehnavi University of Vienna Aveed Raha Phd Student Yuri Yegorov Seniour Researcher View Abstract
The European Union's Energy Security: the Case of Natural Gas Supply Boyko Nitzov Damjan Zagožen Agency for the Cooperation of Energy Regulators View Extended Abstract View Paper
Natural Gas Supply Diversification in Eastern Europe and Long-Term Opportunities from Domestic Shale Gas Resources: A Modelling Approach Using the Global Gas Model Fabian Stähr DIW Berlin, RWTH Aachen University Philipp M Richter Franziska Holz DIW Berlin Reinhard Madlener Christoph Hilgers RWTH Aachen University View Abstract
^ Back to top
2. Risk Issues in Electricity Markets (Manyas 1)
Baris Sanli, Presiding Head of LPG Department Energy Market Regulatory Authority
Flexibility-Enabling Contracts in Electricity Markets Rahmat Poudineh Oxford Institute for Energy Studies Luis Boscán Department of Economics, Copenhagen Business School View Abstract
The Impact of Market Liberalisation on Investment in Electricity Sector in ASEAN Tue Anh Nguyen University of Greenwich View AbstractN View Paper

The Value of ICT Platform Investments within Distributed Energy Systems Ernesto M Garnier Reinhard Madlener RWTH Aachen University View Abstract
Day-ahead Power Prices Influenced by Intermittency: Effect on the Forward Risk Premium Mehtap Kilic Erasmus School of Economics View Extended Abstract View Paper
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3. Climate Change 1 (Anka 1-2)
Jean-Michel Glachant , Presiding Director, Florence School of Regulation European University Institute
Evaluating Multiple Emission Pathways for Fixed Cumulative CO₂ Emissions from Socioeconomic Perspectives Ken'ichi Matsumoto The University of Shiga Prefecture Michio Kawamiya Kaoru Tachiiri Japan Agency for Marine-Earth Science and Technology View Extended Abstract View Paper
R&D, Endogenous Substitution and Climate Change Youngho Chang Di Yin Yang Tang Nanyang Technological University View Abstract
Convergence of Carbon Dioxide Performance Across Swedish Industrial Sectors: An Environmental Index Approach Runar Brännlund Professor, Centre for Environmental and Resource Economics, Umeå University View Abstract
Climate Change Beliefs, Ideological Orientation, and Environmental Values: An Empirical Cross-country Analysis Andreas Ziegler University of Kassel View Extended Abstract
^ Back to top
4. IAEE Student Best Paper Award Competition (Kirlangic 3)
Einar Hope , Presiding Professor of Energy Economics Norwegian School of Economics & Bus. Admin.
Welfare Implications of Capacity Markets in the Electricity Sector Raul Bajo-Buenestado Rice University View Extended Abstract View Paper
Market Failure Caused by Wind-Power Integrations in a Competitive Electricity Market with Transmission Congestions Yang Yu Stanford University View Extended Abstract View Paper
The Impact of Environmental Policy on Welfare and Growth Giacomo A Schwarz ETH Zurich & MIT View Extended Abstract View Paper
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5. Electricity Modelling (Turna 1)
Reinhard Madlener , Presiding Full Professor of Energy Econ Mgt RWTH Aachen University
Demand Response – Temporal Availability and Actual Use for the Electricity System Theresa Müller Chair of Energy Economics, TU Dresden View Extended Abstract

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<p>Forecasting Electricity Consumption with Markov Switching Autoregressive Model Gülsüm Akarsu Ondokuz Mayıs University View Extended Abstract View Paper</p>
<p>Toward a New Pricing Scheme in the Electricity Retail Market Kwami Senam A Sedzro Alberto J Lamadrid Mooi Choo Chuah Lehigh University View Abstract</p>
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<p>6. Energy Forecasting 1 (Turna 2-3)</p>
<p>Lars Bergman, <i>Presiding</i> Former President and Professor Stockholm School of Economics</p>
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<p>Will the EU Reach its 2020 Targets for Renewable Energy? A Critical Evaluation of the Model-based Progress Assessment Lukas Liebmann Gustav Resch Vienna University of Technology, Energy Economics Group (EEG) View Abstract</p>
<p>Dynamic Forecast Combination under Consideration of a Error Forecast Model for Prediction of Wind Energy Mathias Kaeso Felix Muesgens University of Technology Cottbus-Senftenberg Oliver Grothe University of Cologne View Abstract</p>
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<p>7. Smart Grids (Kirlangic 2)</p>
<p>Youngho Chang, <i>Presiding</i> Nanyang Technological University</p>
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<p>An Analysis on the Smart Community Connecting Commercial and Residential Sectors Yoshiki Ogawa Professor, Toyo University View Extended Abstract View Paper</p>

<p>How Smart are Electricity Users with 'Smart Metering'? A Behavioural Economics Experiment Simon L Bager Luis Mundaca International Institute for Industrial Environmental Economics, Lund University View Extended Abstract View Paper</p>
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<p>Andreas Goldthau, Presiding Professor Harvard University & Central European University</p>
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<p>Oil and Unemployment in a New-Keynesian Model Veronica Acurio Vasconez Université Paris 1, Paris School of Economics View Extended Abstract</p>
<p>Disentangle the Interactions Between Global and Regional Seasonality of Crude Oil Consumption: Some Empirical Findings Jun Li Curtin University Jason Park Julian Inchauspe Curtin University View Extended Abstract</p>
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<p>Nevenka Hrovatin, Presiding Professor, Faculty of Economics University of Ljubljana</p>
<p>Measuring the Efficiency of Energy-intensive Industries Across 23 EU Countries Georgia Makridou Kostas Andriosopoulos ESCP Europe Business School Michael Doumpos Technical University of Crete Constantin Zopounidis Technical University of Crete & Audencia Group View Extended Abstract</p>
<p>A Structural and Dynamic Approach to Measuring Rebound Effect in China's Industrial Subsectors Baiding Hu Lincoln University View Extended Abstract View Paper</p>
<p>Effects of Energy Audits on the Adoption of Energy Efficiency Measures Joachim Schleich Grenoble Ecole de Management Simon Hirzel Tobias Fleiter Fraunhofer Insitute for Systems & Innovation Research View Extended Abstract</p>
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10. Geopolitics of Gas 2 (Manyas 2)
<p>Franz Hubert, Presiding</p> <p>Professor</p> <p>Humboldt-Universitat zu Berlin</p>
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<p>Comparing Natural Gas Supply Disruption Scenarios</p> <p>Hari Malamakkavu Padinjare Variam</p> <p>Kamal Soundararajan</p> <p>Energy Studies Institute, NUS</p> <p>View Extended Abstract</p>
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11. Electricity Markets (Manyas 1)
<p>Einar Hope, Presiding</p> <p>Professor of Energy Economics</p> <p>Norwegian Sch. of Econ. & Bus. Admin.</p>
<p>A Framework for Designing and Categorising Capacity Markets - Insights from an Application to Europe</p> <p>Jenny J Riesz</p> <p>UNSW Australia</p> <p>Greg Thorpe</p> <p>Oakely Greenwood</p> <p>Regina Betz</p> <p>Johanna Cludius</p> <p>Zurich University of Applied Sciences</p> <p>View Extended Abstract</p>
<p>Real-time versus Day-ahead Market Power in a Hydro-based Electricity Market</p> <p>Thomas P. Tangerås</p> <p>Research Institute of Industrial Economics</p> <p>Johannes Mauritzen</p> <p>Norwegian School of Economics</p> <p>View Abstract</p>
<p>Old vs New Thinking in Designing Future Electricity Markets</p> <p>Hans Auer</p> <p>Reinhard Haas</p> <p>EEG, TU Wien</p> <p>Georg Erdmann</p> <p>TU Berlin</p> <p>View Abstract</p>
<p>Short-Term Price and Volume Interactions in an Integrated Gas- and Electricity Market Framework</p> <p>Ozge Ozdemir</p> <p>Marit Van Hout</p> <p>ECN</p> <p>View Extended Abstract</p>
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<p>Reinhard Haas, Presiding</p> <p>Professor</p> <p>Vienna University of Technology</p>

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Assessing the Effects of Climate Policy on Firms' Greenhouse Gas Emissions Ana Maria Montoya Gomez Markus Zimmer ifo Institute View Extended Abstract
Evaluating the Emissions Implications of Policies to Promote Clean Technologies Joel R Landry The Pennsylvania State University Richard Klotz Cornell University Antonio M Bento Cornell University and the National Bureau of Economic Research View Abstract
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13. Regional Approaches to Renewable Energy (Kirlangic 3)
Mustafa Ozgur Berke, Presiding Climate & Energy Programme Supervisor WWF-Turkey
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Renewable Energy Consumption, CO₂ Emissions and Economic Growth in Malaysia A.A. Azlina Mahirah Kamaludin Universiti Malaysia Terengganu View Extended Abstract
Prospects for Renewable Energies in Europe up to 2030 Gustav Resch Sebastian Busch Lukas Liebmann TU Vienna, Energy Economics Group View Abstract
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Olvar Bergland, Presiding Professor Norwegian Univ of Life Sciences
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How Much Transmission Capacity will Europe Need in 2050? Richard Green Iain Staffell Imperial College Business School

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Simulation of the Turkish Transmission Grid and Power System Operation with Increased Renewable Shares 2030, and Analysis of the Pumped Hydro Potential in Turkey Gerhard Totschnig André Ortner Gustav Resch Ricki Hirner Vienna University of Technology View Abstract
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Dmitry Sokolov, Presiding Researcher Asia Pacific Energy Research Centre (APERC)
Is Sunshine the Best Disinfectant? Determining the Effectiveness of the Extractive Industries Transparency Initiative (EITI) Goetz Walter Int. School of Mgmt. ISM Benjamin Sovacool Aarhus University View Abstract
The Comeback of Coal in the First Decade of the 21st Century Jorge Blazquez Tarek N. Atallah KAPSARC View Extended Abstract
The Increasing Role of Coal in Energy Balance of APEC Economies for the Period till 2040 Dmitry Sokolov Naomi Wynn Asia Pacific Energy Research Centre (APERC) View Extended Abstract View Paper
Analysis of the Potential Coal Production Peak in China and India: Impact on International Gas and Coal Markets Nikolay Arkhipov Irina Mironova Energy Research Institute of the Russian Academy of Sciences View Extended Abstract View Paper View Conference Presentation
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16. Impacts of Renewable Generation 1 (Kirlangic 2)
Aaron Praktijnjo, Presiding TU Berlin
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The Effect of RES in the Italian Electricity Market Lucia Visconti Parisio University of Milan-Bicocca Angelica Gianfreda Energy Markets Group, London Business School View Extended Abstract
The Impact of Electricity from Renewable Energy Sources on Distribution Grid Congestion Hans Schermeyer Philipp Ringler Valentin Bertsch Wolf Fichtner Karlsruhe Institute of Technology/Chair of Energy Economics View Abstract
Electricity Market Equilibria with High Shares of Wind Power Thomas Möbius Felix Müsgens University of Technology Cottbus-Senftenberg View Extended Abstract View Paper
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17. Fossil Fuel and Renewable Electricity Subsidies (Manyas 3)
Sevil Acar, Presiding Assistant Professor Kemerburgaz University View session description
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Subsidies and Renewable Incentives in Turkish Energy Market and Their Effects Baris Sanli Energy Market Regulatory Authority, Turkey View Abstract
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18. Consumer Preferences and Environmental Consciousness (Anka 3)
Carlo Andrea Bollino, Presiding Professor Dipartimento di Economia, Università di Perugia
The Willingness to Pay of Swiss Households for a Reliable and Green Electricity Supply: A Discrete Choice Experiment Alessandra Motz Rico Maggi Stefano Scagnolari Università della Svizzera italiana View Extended Abstract View Paper
Smart grids and consumers attitude towards sustainable development Simona Bigerna Carlo Andrea Bollino University of Perugia View Abstract
The Social License to Operate: Examining the Social Acceptance of Firm Operations in Multi-Stakeholder Complex Environment Piyali Rudra Doctoral Researcher, Aalto School of Business View Extended Abstract
Customers' Valuation of Grid Resilience to Extreme Events: Willingness to Pay and Preference Heterogeneity Laura-Lucia Richter Cambridge University View Extended Abstract View Paper
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Christophe Bonnery, Presiding Director Economics & Energy Policy ERDF
Capitalization of Residential Energy Efficiency Erdal Aydin Dirk Brounen Tilburg University Nils Kok Maastricht University View Extended Abstract
Money, Comfort or Environment? - Priorities and Determinants of Energy Efficiency Investments in Irish Households Claudia Aravena Eleanor Denny Trinity College Dublin Andres Riquelme North Carolina State University View Extended Abstract

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<div>Gas Pricing System in the Asian Pacific Market : Influence of Europe and USA Jinseok Sung Gubkin Russian State University of Oil and Gas View Extended Abstract View Paper</div>
<div>Imposing Netback Prices on Natural Gas in Russia Knut Einar Rosendahl Norwegian University of Life Sciences View Abstract</div>
<div>The Price Dynamics in Japanese and European LNG Markets Ziya Cologlu PhD Candidate, University of Texas at Dallas View Extended Abstract</div>
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<div>Regina Betz, Presiding Joint Head EPAG SML-ZHAW</div>
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<div>Short-Term Energy Storage for Stabilizing the High Voltage Transmission Grid: A Real Options Analysis Reinhard Madlener Katrin Illian RWTH Aachen University View Abstract</div>
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<div>Fengjun Duan, Presiding Canon Inst. of Global Studies</div>

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<div>Azlina Abd Aziz, Presiding University Malaysia Terengganu</div>
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<div>Yukari Yamashita, Presiding Board Member Director Institute of Energy Economics</div>
<div>The Interactions Between Residential Electricity Consumption and the Power Sector Within an Economic Equilibrium Framework: A Look at Energy Efficiency in Saudi Arabia</div> <div>Walid Matar Research Associate, King Abdullah Petroleum Studies and Research Center View Extended Abstract View Paper</div>
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Korea Electric Power Corporation (KEPCO) Research Institute

[Jaewoong Lee](#)[Jiyong Eom](#)

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Professor

Istanbul Technical Univ.

Assessing the Stakeholder Support for Different Biofuel Options in France by 2030: A Range Based Multi-Actor Multi-Criteria Model[Gino Baudry](#)

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Assistant Professor

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Comparing the Whole-system Costs of Baseload Power from CSP and Nuclear Power Plants Under High Renewables Scenarios for the Case of South Africa[Stefan Pfenninger](#)[James Keirstead](#)

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John Felmy , Presiding Chief Economist American Petroleum Institute
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The World Oil Market: A Dynamic Model of Strategic Supply Nathan Balke Southern Methodist University Mine Yücel Federal Reserve Bank of Dallas Xin Jin University of Aberdeen View Abstract
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28. Energy Transition & Demand Side Management. in Industry (Anka 3)
Joachim Schleich , Presiding Professor Fraunhofer Inst Sys Innov Research
Review of Barriers to Uptake of Demand Side Response in Medium Sized Businesses Mitchell Curtis University of Reading View Extended Abstract View Paper View Conference Presentation
Recent And Future Development Of Demand Side Flexibility In Industry Marian Klobasa Fraunhofer Institute for Systems and Innovation Research ISI View Extended Abstract
Heat Demand in the German Industrial Sector - The Combined Heat and Power (Co-Generation) Potential until 2030 and Contribution to Flexibility Felipe Toro IREES GmbH, Germany View Extended Abstract
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Mark Stickells , Presiding Director Energy and Minerals Institute, The University of Western Australia
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30. Outlook of the Turkish Energy Sector (Anka 4)
Oguz Can, Presiding Recydia A S
Eastern Hub of the Western World - Turkey's Role on EU's Security of Supply Mehmet Fatih Baltaci Chairman, Akfel Holding View Abstract
Solar Future In Turkey Kemal G Bayraktar President, GÜNDER / Turkish Solar Energy Association View Abstract
Cross Border Trade in Electricitiy: Bulgaria, Greece, Georgia, Turkey Mario Diel CEO, Alpiq View Extended Abstract
The View on the Future of the Turkish Energy Sector from a Foreign Investor Martin Pacovský Deputy CEO, Akenerji / Country Manager, CEZ Turkey View Abstract
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Volkan Özdemir, Presiding Chairman Inst for Energy Markets and Policies
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Changing Gas Price Mechanisms In Europe And Russia`s Gas Pricing Policy Tatiana Mitrova Head of Oil and Gas Department , Energy Research Institute of the Russian Academy of Siences (ERIRAS) View Extended Abstract
Gas Import Pricing of Turkey: In or Out Of European Market? Volkan Özdemir EPPEN (Institute for Energy Markets and Policies) View Abstract
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32. Interconnection of Electricity Markets (Manyas 1)
Jurgis Vilemas , Presiding Leading Scientist Vytautas Magnus University
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Capacity Adequacy in Interconnected Electricity Markets Camila Ochoa Ann van Ackere University of Lausanne View Abstract
Expert Survey on Cross-border Effects of Capacity Markets in the U.S.: Lessons for the EU Pradyumna C Bhagwat Laurens J De Vries Delft University of Technology Benjamin F Hobbs The Johns Hopkins University View Extended Abstract View Paper
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Mark Stickells , Presiding Director Energy and Minerals Institute, The University of Western Australia
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<p>Kemal Sarica, Presiding Assistant Professor ISIK University</p>
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<p>Andrew Pickford, Presiding Adjunct Research Fellow University of Western Australia</p>
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<p>Peter Howie, Presiding Nazarbayev University</p>

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Evaluating the Welfare Impacts of Changes in Energy Supply Vidas Lekavicius Arvydas Galinis Lithuanian Energy Institute View Extended Abstract
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Andreas Löschel, Presiding Professor University of Münster
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Erol Metin, Presiding Energy & Logistics SEM Sustainability
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Shale Gas and Energy Markets in Transition: Lessons from North America**Hillard G Huntington**

Executive Director, EMF, Stanford University

[View Extended Abstract](#)**Pathways to Shale Gas Development in Asia Pacific****Juan Roberto Lozano-Maya**

Researcher, Asia Pacific Energy Research Centre (APERC)

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[View Extended Abstract](#)**The US Natural Gas Market Turned Upside Down - Marcellus Changes Everything****Robert E Brooks**

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Adjunct Research Fellow

University of Western Australia

Planning in Restructured Electricity Industries - Lessons from Australia's National Electricity Market**Neil Raffan****Iain MacGill****Anna Bruce**

University of New South Wales

[View Extended Abstract](#)**What Role for Renewable Energy from North Africa, Western Balkans and Turkey?****Andre Ortner**

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Senior Research Fellow

Oxford Institute for Energy Studies

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